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ABSTRACT

This digest contains four articles about technology and education in Britain. "The Development of an 'Additional Skills' Training Programme" (Peter Riley) details the organization and progress of a collaborative effort between Blackpool Processing Company and Flyde College's Additional Skills training program, a solution to achieving the flexible work force necessary in the 1990s. "Funding CNC Machine Tool Purchases in FE Colleges: Summary and Recommendations of an Evaluation Report" (Albert Clyde, Arthur Hambly) presents findings and recommendations on a funding scheme for computer numerical control in further education colleges. It notes that the result far outweighed the amount of funding involved--departments achieved a new utility to local industry. "Satellite Communications for Further Education" (Jim Stevenson) describes the importance and appropriateness of distance education in a country the size of Britain. "Attaining Competence in Engineering Design" (Colin Ledsome) deals with design education's background and the impact that it will have on changing technologies. (NLA)

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FEU

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No. 3

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The Further Education Unit (FEU) was established by the Department of Education and Science to give guidance and support to the further education system. FEU advocates and seeks to make possible a more co-ordinated approach to curriculum development, in support of its remit to promote, encourage and develop better learning opportunities in further education. For more information, please contact:

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Acronyms and Abbreviations

ASC	Additionally Skilled Craftspeople
BTEC	Business and Technician Education Council
C & G	City and Guilds
CNC	Computer Numerical Control
DTI	Department of Trade and Industry
ERA	Education Reform Act
ITP	Individual Training Programme
NC	Numerical Control
NVQ	National Vocational Qualification

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Editorial

Peter Ingham

This is the third issue of the Technology Digest and we hope that you will find it interesting and useful.

When discussing training it is almost a cliché to state that British manufacturing firms have little interest in training compared with our trade competitors. It is a welcome change to read our first article, describing a collaborative project between an enterprising FE college and a company involved with processing. Our contributor, Peter Riley, details the organisation and progress of Blackpool and The Fylde College's 'Additional Skills' training programme, which makes heartening reading. Both the college and the company are firmly committed to Additional Skills training, which seems to be an excellent solution to the problem of achieving the flexible work-force necessary in the 1990s. He outlines the procedures needed to set up a programme — invaluable reading for colleges considering developments in this field.

Probably the most significant change in the manufacturing departments of colleges during the last 20 years was caused by the Department of Trade and Industry's injection of funding for Numerical Control (NC) equipment in the early 1980s. This had an effect which far outweighed the amount of funding involved — departments, almost overnight, achieved a new confidence and utility to local industry. The DTI commissioned FEU to prepare a report on the effects of the funding scheme and Albert Clyde of FEU directed the investigation. Arthur Hambly, a former lecturer in Production Engineering was the consultant. We include a summary of their findings and recommendations on issues which must be considered by any establishment trying to keep up to date in the provision of new technology training.

Many colleges are now involved with satellite communications and we thought it appropriate to include an article on this important and influential field. The Educational Broadcasting Services Trust is an educational charity involved in the production of audio-visual material for educational purposes. Among their many activities are the production of materials for the blind and making videos of experiments too dangerous to perform in normal teaching curricula. Currently they are involved, with a consortium of about 50 colleges, in the production of a 'Skill Bank' of video material illustrating NVQ competences. Dr Jim Stevenson, their Chief Executive, has written a thought-provoking article on satellite communications. Countries such as Canada, the United States and Australia are highly committed to the newer communications techniques in education. This is primarily because of their size. Dr Stevenson, however, stresses the importance and appropriateness of the techniques in this country also.

The teaching of Design has been the subject of controversy for many years. Broadly, opinion is divided into two camps: those who consider that it is a subject with its own corpus of knowledge which should be taught in its own right, and those who consider that Design is the most important integrating agent in Engineering courses and should be regarded as a part of all subjects taught. Colin Ledsome of the Design Council is Secretary to the Joint Design Council-Engineering Council Working Party established in 1989 to 'expand and clarify the nature and attainment of engineering design competence for Chartered Engineers'. They have produced a detailed report *Attaining Competence in Engineering Design* (ACED), which should be compulsory reading for everyone involved in teaching Design. Colin, who has been influential in the field of Design Education for some years, has produced an article based on the report, dealing with its background, the discussion that it has already generated and the impact that it is likely to have.

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We welcome your comments on the contents of previous Technology Digests and on the articles you would like to read in future issues. Would you please help us by completing and returning the survey at the back of this edition.

The Development of an 'Additional Skills' Training Programme

Peter Riley
Blackpool and The Fylde College

INTRODUCTION

The concept of a flexible work-force achieved through multi-skills training is not new. Reduced labour costs and increased efficiency are attractive goals, but many early attempts to attain them failed because of the difficulties inherent in the process.

This paper is concerned with the efforts of one large process company currently implementing an ambitious training programme using the services of a local FE college.

Total flexibility was never the intended outcome of this programme. The continuing importance of the 'core skills' of existing craftspeople was seen as a foundation upon which 'additional skills' could be built. Carefully managed, this approach gained support from the work-force and is calculated to produce a significant reduction in operating costs for the company over five years.

The activities associated with each operational element are described in detail and an initial emphasis is placed upon the importance of a careful 'needs analysis' prior to the programme design. This is followed by a section stressing the importance of 'training preparation' and the crucial issues relating to attitudes at both management and craft level.

Assessment and external accreditation were regarded by the company as essential to the credibility of the programme. 'On-the-job' assessment supervised by more senior company personnel was agreed to be the most effective approach. Assessment criteria were also devised for the comprehensive range of elements of competence determined by the company.

The paper concludes with observations and recommendations based on the experience gained throughout the implementation of the project. Many of these are positive and the training programme proved to be an important learning vehicle for both FE and industry. Problems for FE have also been identified and these have broader implications for colleges facing increasing demands for commercial training services alongside existing FE provision.

1 Skills needs analysis:

1.1 Any comprehensive training programme should be based on a detailed analysis of the skills actually being applied in operations within the company rather than on an assumption that all the traditional engineering skills acquired during a conventional apprenticeship will be relevant. To be cost effective, additional skills should be generated to satisfy specific company needs.

1.2 Company managers carried out this investigation and identified the detailed needs addressed by this programme.

1.3 A realistic view was taken of the subsequent application of these additional skills. A comprehensive training programme may produce a broader range of skills within each craftsperson or operative, but these are unlikely to be achieved at the same level as the core skill that they already possess. This was an important concept for all supervisors and managers within the company to accept and the more reactionary senior personnel had some difficulty, at first, in acknowledging the value of a lower 'grade' of core skill in achieving greater operational flexibility., One method of overcoming this problem was to make it clear that the supervisor responsible for a particular operational area would be the person to make a judgement on the level of skill required for a specific task. If a very high level of skill was essential, only personnel possessing the relevant core skills were selected to undertake the work.

1.4 It was considered prudent to recognise that in the application of a more flexible work-force, newly acquired skills needed practising since investment in training to develop skills subsequently little used would be wasteful. The skills needs analysis therefore clearly identified the relative scale of demand to be anticipated in each skill area and this was reflected by an appropriate 'weighting' in the training programme.

2 Personnel preparation:

2.1 The whole engineering management team was briefed about proposals for the implementation of a pilot scheme for 'Additionally Skilled Craftspeople' to ensure

that the concept was clearly understood within the company as early as possible.

2.2 Briefings were held for trade unions and all other industrial personnel, including non-craft and apprentices who, though not directly involved, could be affected by the scheme.

2.3 Following group briefings, plant engineers discussed the concept of the scheme with each craftsperson individually to clarify any concerns arising from the group briefings, to confirm their commitment to participate or to indicate to some the likelihood that they would be excluded from the scheme.

2.4 Each participating craftsperson was given a list of skill content for all the units of competence available. Following Attitude Testing, each individual was seen again by the Plant Engineer and their line manager to discuss the selection of units for their Individual Training Programme (ITP). Although the Engineering Management reserved the right to have the final say, selection of ITPs was decided amicably where possible. Individuals were also given time to consider their ITP before being asked to confirm their agreement.

3 Training preparation:

3.1 Some form of induction is essential in any comprehensive training programme. The purpose of a new programme should be clearly perceived by all personnel within the company so priority was given to creating a positive attitude to training in all those involved.

3.2 'Participative learning' techniques were recommended for direct industrial training. This approach requires a much more active role on the part of the learner group in attaining their learning goals than more conventional teaching methods. Another benefit is that 'expert' trainers are not required to lead the sessions, which enables the Plant Engineering Management to perform the role. This gives them a chance to demonstrate their enthusiasm and commitment to the ASC concept and to aid the team-building process that underlies it.

3.3 All technical units within a programme were based on the 'activity' list produced during the 'Skills needs analysis'. Each activity list was restructured into a 'unit of competence' format to achieve accreditation from external validating bodies - e.g. the City and Guilds of London Institute.

3.4 Each unit was prepared by a team comprising a broad spectrum of staffing expertise from both the company and the training organisation. Each team was allocated a nominated company 'assessor' to advise on technical content and to evaluate the relevance to subsequent on-the-job assessment.

3.5 Company assessors were usually line managers and supervisors because:

the highest level of skill competence normally resides in this group and consequently they should be the best judges of skill level;

they are able to review the relevance, validity and skill level of training and assessment in their own core skill areas and so provide valuable and reliable feedback.

3.6 Units were divided into three principal areas:

one or more elements of competence
bench-mark tests
accreditation procedures

3.7 Associated training manuals were prepared which included the following three main sections:

tutor notes - objectives, lesson plans, methodology, etc;
worksheets - instructions, questions, learner input, etc;
handouts - references, guidance, diagrams, notes, etc.

4 Assessment:

4.1 It was a company requirement that each unit of competence should be assessed following the first 'off-the-job' element of training. This assessment was carried out by the training organisation.

4.2 Assessment following 'on-the-job' training and practical experience was required by the external validating body and carried out by accredited company

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personnel. This process needed thorough preparation and prior approval by the validating body.

4.3 Assessment checklists were prepared for the practical assessment of each unit and sufficient banks of questions prepared for each theory examination to allow reasonable variation in test papers applied.

4.4 Assessment checklists also led to an increase in the consistency of assessment and, as they were also made available to craftspeople undergoing training for reference purposes, they acted as an aid to assessment of prior experience.

5 Summary of conclusions for FE:

5.1 Many innovative approaches and techniques have emerged as a consequence of this project, ranging from the evaluation of the direct financial gains that may be achieved by a company through an effective training programme to the demonstrable way in which the staff of an FE college can support and enhance this process.

5.2 A brief summary of other benefits associated with this initiative:

FE staff have experienced direct involvement in the planning and creation of industrial training with a view to increasing staffing flexibility and quantified efficiency.

Company/college/City & Guilds collaboration has achieved nationally recognised accreditation in NVQ format.

A 'bench-mark' concept has been developed to promote standardisation in on-the-job assessment.

Skills auditing techniques have been developed to measure the subsequent degree of application of acquired additional skills.

Project management and co-ordination skills have been gained by FE staff in a real industrial situation.

FE staff have forged stronger links with industry through joint operations and staff now spend a significant amount of time working within a company.

The team-building process within the college has been accelerated and reinforced across two departments.

The college is perceived by the industrial community as a dynamic source of innovation and expertise.

The college has learned the quality standard and commercial efficiency demanded in a modern industrial environment.

Other important companies within the community are actively pursuing similar projects and are anxious to make use of the experience of the college staff.

5.3 A brief summary of problems for FE that arose during the project:

This programme involved a large number of training modules with a mean length of 40 hours each. Over 20 members of the FE teaching staff were employed in the delivery of these modules according to a schedule determined by the company. This resulted in a continuing disruption to normal FE provision within the college.

The commercial and administrative infrastructure required in support of large-scale industrial training projects has yet to be properly established alongside the traditional public service bureaucracy still prevalent in FE institutions.

Few industrial training projects are likely to offer a long-term guarantee of employment for FE staff. Strategic planning requires careful judgement if a college is to maintain balanced provision, stability and future success.

6 Summary of conclusions for Industry:

6.1 Due to historic changes in the pattern of apprentice training, coupled with the wide contextual variations in work experience, it should not be assumed that all existing skilled personnel would immediately be able to start an ASC training programme from the same base reference point. Some form of pre-programme 'balancing' or 'consolidation' may be required and this would have to be devised according to individual trainee needs.

6.2 Production schedules may require amendment to accommodate the demands of the training programme. Off-the-job training causes the absence of production personnel. On-the-job training frequently demands process intervention to provide relevant practical experience and assessment.

6.3 The scheduled completion period for even a large-scale training programme should be kept to the very minimum. Interest and commitment invariably wane and company priorities may change. Distance learning techniques can help to compress programme schedules.

6.4 Some form of rewards system would normally be regarded as essential in providing an incentive to unreserved commitment from trainees.

6.5 If an external training organisation is employed by a company to devise, co-ordinate and deliver an ASC training programme, this organisation should be clearly perceived as an impartial and professional body representing programme rather than management interests.

6.6 All training programmes should incorporate a thorough and effective monitoring and evaluation process.

6.7 Maintaining a flexible work-force in the long term requires a commitment to a continuing programme of ASC training. A dynamic database containing all acquired skills is essential as a reference for the effective application of this important personnel resource.

ADDITIONAL SKILLS TRAINING MODULES:

01	Isolation and Safety
02	AC Electrical Systems (240V)
03	AC Electrical Systems (415V)
04	Computer Systems
05	Electric Motors and Control Systems
06	Instrumentation Systems
07	Measurement Systems
08	Transmission Components and Glands
09	Hydraulic Systems
10	Pneumatic Systems
11	Mobile Plant
12	Metal Structures
13	Plumbing Components and Systems
14	Plastic Pipework
15	Metal Welding and Forming

Funding CNC Machine Tool Purchases in FE Colleges
Summary and recommendations of an evaluation report

Albert Clyde (FEU) and Arthur Hambly (Consultant)

INTRODUCTION

This article describes the issues that arose during an FEU investigation into the operation of the DTI scheme for funding the purchase of CNC machine tools in FE colleges, together with recommendations drawn from them. This DTI scheme began in 1983 and operated for two years.

The objectives of the evaluation of the scheme were to assess its impact on the provision of CNC equipment in FE colleges in view of the courses offered, and the contribution the equipment made to the education and training of the students geared to the needs of industry.

FEU undertook a survey of approximately ten per cent of the colleges, local education authorities (LEAs) and representative firms who used the colleges to provide training or updating schemes for industrial employees. In all, 36 colleges, 10 LEAs and 42 companies were contacted (see table 1).

The recommendations are mainly intended to give guidance to government departments, LEAs, colleges and companies, about essential considerations relating to the development of engineering provision in further education, with particular regard to the provision and maintenance of up-to-date equipment.

PLANNING ISSUES

The DTI scheme pre-dated the formal planning requirement on LEAs with regard to work-related non-advanced further education (WRNAFE) now maintained further education (MFE), and at that time only one local authority contacted had a specific policy for the development of engineering education; however, the planning experience gained during this scheme was put to good use by the LEAs on the introduction of the WRNAFE planning process.

At the time of the scheme few colleges had formal systems for marketing their facilities.

Table 1: Information on population and sample

Amount of DTI support L	Total colleges supported		FEU sample	
up to 10,000	142	(42%)	13	(36%)
10 - 19,999	125	(38%)	10	(28%)
20 - 29,999	47	(13%)	8	(22%)
30 - 39,999	18	(5%)	4	(11%)
over 40,000	7	(2%)	1	(3%)
Totals	339	(100%)	36	(11%)
Expenditure L	5,000k	(100%)	562k	(11%)

LEAs' monitoring of the impact of the scheme on curriculum development and provision varied according to the role each LEA played in the scheme and was mainly through informal feedback.

Engineering education received a boost which affected its profile and provision. As a result of their experiences with the DTI scheme, LEAs and colleges initiated a collective approach to determining CNC training needs of industry.

When the DTI scheme started, approximately 89% of the sample colleges possessed some CNC machine tools. These colleges used the scheme to complement their existing equipment.

Recommendations

LEAs' and colleges' formal marketing policies should ensure that:

- **they are aware of industries' training needs;**
- **industry is aware of the colleges' services;**
- **they can prepare and seek to implement, when appropriate as part of the MFE and ERA planning process, plans to provide sufficient new technological equipment to meet the training needs of industry.**

LEAs' monitoring and evaluation procedures should be sufficiently flexible to allow for the evaluation and review of the effects of major initiatives.

FINANCIAL ISSUES

At the time of the DTI scheme, LEAs were subject to restrictions in their capital expenditure and colleges were in competition for limited resources; within each college, various departments needed to be re-equipped in response to developments in information technology. Authorities had found it extremely difficult to allocate sufficient resources for this purpose, especially in view of the Department of the Environment's rules concerning the upper limits of equipment purchases from revenue. The cost of many CNC machine tools is such that even the 50% LEA contribution was above the revenue expenditure limit. In purchasing larger machines, LEAs therefore had to find their contribution from very tightly controlled capital allocations, which in many cases could not even meet priority capital works.

In every case, LEAs and colleges used the scheme to enhance equipment purchase by upgrading the type and/or number of machines purchased, or by accelerating the rate of purchases; however, in 89% of the colleges there had been displacement of finance within the LEA or college budget.

There was no significant financial contribution from industry towards the cost of the scheme.

Local authority financial planning rounds require up to three years' forward planning for capital expenditure; schemes such as this demand a quicker response.

College services and courses in CNC training and updating were considered to be underpriced and therefore risked being undervalued.

The ability of colleges to retain and recycle income from courses proved to be an incentive for vigorous short-course training provision and acted as a boost to staff morale.

LEAs and colleges made little provision for the costs of maintenance or modernisation and updating of the hardware and software purchased under the scheme; this put the gains in technological equipment, arising from the DTI initiative, at risk.

Recommendations

- **While current government policies on LEA expenditure exist, national initiatives of this kind should be considered at regular intervals, to ensure the provision and updating of the specialised equipment that colleges require to enable them to meet the basic training needs of industry.**
- **Government departments should liaise with each other to harmonise the aims and operation of related national initiatives.**
- **Industrial contributions towards the funding should be encouraged at national and/or local level through reciprocal benefits, such as preferential arrangements for training on the equipment provided for an agreed period.***
- **Colleges should charge realistic fees for training and consultancy services.**
- **Provision should be made by LEAs to cover the cost of the maintenance and updating of new technological equipment in their FE colleges.**

** See Extending College/Industry Links for New Technology Training (FEU, 1989).*

EQUIPMENT ISSUES

Although industrialists made little financial contribution to this scheme, they often advised on suitable equipment via college advisory committees or individual consultation between colleges and specific local employers.

Colleges mainly purchased machines of light industrial standard, but those which obtained training machines also considered they had received a valuable addition to their resources.

Industrialists generally believe that the DTI initiative had equipped colleges to provide basic awareness training in CNC together with the background theory; in some cases, however, colleges were enabled to provide a much wider range of services.

Provision for training of lecturing staff was generally adequate, but support staff training was less formal and less effective.

Recommendations

- **Advice from industrialists should normally be sought by LEAs/colleges on the type of equipment needed to meet local industrial needs.**
- **Colleges which have modern, industrial-standard CNC equipment available for training purposes should ensure, as part of their promotional activities, that local industry is aware of their facilities and range of services on offer.**
- **Provision for training of college technicians in maintenance techniques for CNC machinery should be more systematic.**

EDUCATIONAL OUTCOMES

Utilisation of the equipment proceeded smoothly and the technology was incorporated into the curricula of existing courses without delay.

Most colleges organised specialised short courses which made use of their new CNC equipment. Demand was high, with most students attending in their own time.

Modes of delivery included 'drop-in' provision and trainees who benefited ranged from apprentice training instructors to single mothers preparing to return to industry or commerce.

As a result of the scheme, colleges provided various forms of self-learning packs; new and improved full-time, day-release, evening and short courses; consultancy; skills needs analyses; and on-site training programmes.

Industrialists expressed a view that the CNC content of C&G and BTEC courses should be increased.

Students' attitudes and motivation improved considerably when given access to the modern equipment.

Many students prepared to attend courses in their own time, and often at their own expense, in order to update their experience in an area of modern technology.

Recommendations

- **In designing courses, colleges should make flexible provision in modes of delivery and use the learning and teaching strategies most suited to the circumstances of the employer and the trainees.**
- **Examination and validating bodies should review their schemes to ensure that they include an adequate proportion of new technology training.**

RELATIONS WITH COMPANIES

Colleges reported an improvement in relations with companies and felt that they were in a position to advise industry on the introduction of new technology.

Colleges acted as 'shop windows' and provided independent advice to companies on the selection of equipment.

Two colleges had been commissioned to act as training agents for machine tool manufacturers.

Recommendations

- **Colleges should use their CNC expertise as a basis for consultancy and advisory services to industry.**
- **Machine tool companies should recognise that colleges often have the expertise to prepare and deliver training as their training agents.**

SURVEY OF INDUSTRIALISTS

Industrialists reported few employees involved in training on specialist short courses in colleges but it became clear that firms are unlikely to have a record of employees who train in their own time and at their own expense. Also, CNC training is an integral part of many general engineering courses leading to qualifications from C&G and BTEC. The C&G 230 course, which is specifically concerned with CNC operations, received support from employees from a number of companies, on a day-release and evening-only basis.

Companies were generally satisfied that the facilities available in colleges were appropriate for basic awareness training, although some indicated that they would

have preferred staff to have received training on industrial-type machines.

Companies thought that there should be a better ratio of machines to students as limited availability of machinery restricted class sizes or caused queuing for the practical aspects of the course. Off-line programming and simulation techniques alleviated this problem and enabled the trainee to test the programming before loading and running the machine.

Recommendations

- **Industrialists should encourage relevant employees to apply for technological updating by the provision of adequate support, such as the payment of course fees and allowing training within working time.**
- **Employers should keep a complete record of employees who have undertaken specific CNC training or CNC training as part of a general engineering course so that they can make the most effective use of their high technology equipment.**
- **Colleges should obtain the appropriate software to introduce off-line programming and simulation techniques.**

CONCLUSIONS

Much has changed since the introduction of the DTI funding scheme in 1983, and even greater changes are ahead. Although some of the issues that arose from LEA/college interaction will not be relevant after 1990, many of the general principles established could be even more important when LEAs are responsible for strategic planning and colleges for the allocation of their budgets. New technology equipment is capital intensive, and student numbers may not appear to justify the investment. Yet we are dealing with the one sector of the economy that **must** prosper. FEU believes that LEA and college strategic planning must take advantage of appropriate government grants or initiatives, and any industrial funds that can be attracted.

Satellite Communications for Further Education

Dr Jim Stevenson
Chief Executive, The Educational Broadcasting Services Trust

Like crocuses in March the first satellite receiving dishes are sprouting from gardens, walls and the flat roofs of colleges. Soon they will be there in thousands, if not millions, before the summer of dis-illusionment sets in and they wither or are recycled into lampshades, plant stands and parabolic bird baths.

Somehow one expects the programmes which have been bounced 47,000 miles into space and back to be better for having taken such a journey. But the viewer at this stage in 1991 might well be disappointed. More choice is still something of an illusion and the enormous potential which the technology brings for increased entertainment, information and education is, as yet, largely unrealised. There seems to be a pause in communications development while the hardware gathers in orbit and before original ideas start up on the ground. It is this pause which educationalists can now exploit.

There are hundreds of communication satellites suspended in orbit above the Equator. They spin around the earth at the same speed as the earth's own rotations and so appear to us to be stationary in the sky. Each occupies an agreed position in space and in order to receive a signal from a particular satellite a receiver dish antenna must be fixed directly facing the satellite. Because each satellite is the same distance from the earth they form a ring which a steerable dish can traverse. So by moving the dish it's possible to receive signals from many sources if they are directly in line of sights, i.e. not behind buildings, trees or below the horizon. The viewer can pick up programmes in French, German, Italian and, with luck, Russian. American films dubbed into German, Italian game shows and the news from the United States and Britain can also be seen all day long. Also available are sport and pop music, wildlife and films for the family. Rumour has it that you can even see soft porn.

But one thing that is definitely not seen, or even scheduled to be seen, is education in any shape or form. Ask any satellite operator if they have ever contemplated education as a major output and the answer you receive will send you scuttling back to the classroom or lecture hall.

So why do we say that satellites have 'potential' for education? The answer, curiously enough, lies in the cousin of satellite – cable.

To the viewer, it does not matter from where the image on the screen comes, be it terrestrial, satellite or cable. A lucky cable subscriber in selected British towns or cities can now receive up to 30 television channels. Some of these originate as satellite signals and are caught by the cable companies with dishes on their roofs and delivered to the subscriber down a wire. The cable company selects a number of services from different satellites using different types of signal and delivers them direct to the user down the same cable. Outside a cable area and with only a satellite dish the viewer is forced to rotate it or have several dishes and decoders to translate the technically very different signals now being transmitted.

So a symbiosis can build up between satellite and cable, the satellites feeding the cable heads with the viewer happily oblivious of the origin and journey paths of each programme.

Although not yet seen in this country, the relationship between satellite and cable, when dedicated to education, can be very close. Both are potentially interactive.

Satellite-delivered education in Canada, the United States and Australia is often live and demands the active participation of the user. The vast geography of these countries means that satellite is virtually the only way of getting a visual image to the student. The telephone provides the interaction: video goes via the satellite to the student, the telephone provides the student with comment and instant help. This type of system need not be merely didactic. Teleconferences between colleges can occur by satellite. Businesses can talk to each other. Whole networks can be hooked together in live interaction.

The same is true of cable but with the advantage of many more channels being available for educational use. In Washington alone there are three cable channels devoted to education and training. Such education can be sharply focused with particular local aspects built in. Colleges can

link up with other local colleges or with adults studying at home or with local businesses. Schools can be linked to each other and to parents. Industry can deliver training or information to its own work-force in the cable area. Local networks can link up with each other by satellite and with a cable/satellite system in place the opportunities become almost endless, particularly if you include transference of data as well as full motion video. A gradually spreading web of communication builds as cable links to cable via satellite or land link.

But you can become carried away with these thoughts and before embarking on any communication venture or on the production of audio or video programmes you should, as a matter of routine, query the reasons for doing so. 'Why do I want my college to be linked to the local community or to a wider network?', 'What can I offer which will be of interest to others?', 'What can this technology do that cannot be done by 'phone or mail?', 'What are the short-term gains and the long-term objectives?'

Fortunately, in the FE sector the answers to these questions are relatively easy. Firstly, many of the subjects taught are visual. They are about skills which can be seen and assessed. Many such skills are fascinating in themselves. The catering industry, engineering, construction, hairdressing, word-processing - all provide opportunities for the demonstration and acquisition of skills which are of real interest both to the committed learner and the merely interested bystander. Just as the well-placed viewing holes around a shuttered building site allow passers-by to watch progress, so television provides a window to those who will look at the detail of best practice or the progressive acquisition of skills or the measurement of attainment at any particular level. Television on hairdressing, for example, would be useful for students of the trade, for qualified professionals and of real interest to the general public. Plumbing, bricklaying, plastering and carpentry would be well used. The showing of office skills would attract potential employees as well as train those in colleges and would inevitably improve the practice of existing businesses. There are many examples.

Satellite and cable can offer to the FE sector an outlet for their wares, a useful mechanism for exchange of wares and a valuable device for publicising, and bringing many more people into, FE and its associated industries. Britain urgently needs a skilled and flexible work-force. We have at our disposal the mechanism with which to contribute. It is important to begin with the programmes themselves and set aside, for the moment, the method of delivery.

Pursuing this aim, a major consortium of FE colleges is currently being established to develop up to 100 hours of video for use in colleges in the delivery of FE curricula and as open learning products for distribution elsewhere. When the consortium has produced a significant bank of video, it will be in a position to restructure this material for local delivery including delivery by cable. Later the material will be delivered to a wider market perhaps by satellite.

In addition, the Olympus satellite, which will carry educational material under the broad title of *Eurostep* is an obvious route for the delivery of such material and once the pattern is established, possibilities of developing further programmes and ideas in and around the FE area will emerge.

We can begin to see the growth of a specific area of 'broadcasting' which offers a continuous service into which users and providers will delve. There could be interactive local services, point-to-point tele-exchanges, international telecourses and conferences as well as an expanding range of new learning packages for both mediated and individual study.

Satellite and cable now make this possible with a window of opportunity beginning to open wide. Perhaps then we need not recycle our parabolic dishes and squarials into bird baths. Rather we should accept that in spite of present programming, the potential for something new and exciting to all of us in education and training is hovering quietly over the Equator.

Attaining Competence in Engineering Design
Colin Ledsome
The Design Council

For over 150 years, as engineering pressed the limits of efficiency, economy and material properties, there was a growing need for rigorous analysis to meet performance guarantees and safety requirements. In response, courses for engineers steadily increased their emphasis on analytical theory. By the early 1960s design had virtually been squeezed out of most degree curricula by engineering science. The Feilden report of 1963, *Engineering Design*, emphasised the importance of good engineering design in mechanical engineering.

A number of reports and papers over the years made similar points and a few isolated innovations were introduced in response, but without really meeting the overall need for change seen by many. The various proposals were summed up in the memorable wording of the Design Council's Moulton report in 1976:

> Engineering should be taught in the context of design, so that design is a continuous thread running through the teaching of undergraduate engineering. Courses should expose the student to a proper mixture of analysis, synthesis, conceptual design and other wider issues.

The Finniston report, *Engineering our Future*, 1980, put a similar emphasis on industrial applications and led to the formation of the Engineering Council. In turn, that body's policy document *Standards and Routes to Registration* (SARTOR), 1984, commending the Moulton statement, made design studies a mandatory requirement in accredited degree courses.

Since then course providers and accreditation bodies have interpreted the SARTOR requirements in such a variety of ways that it has become impossible to say that standards are equivalent in the different parts of the profession. This joint Design Council-Engineering Council Working Party was therefore charged with producing some form of bench-mark against which the design standards of academic formation for all engineering disciplines could be measured. Their final report, *Attaining Competence in Engineering Design* (ACED) will be published in the Autumn.

'Design' has different shades of meaning depending on the context. In ACED 'engineering design' is defined as that activity which leads to the complete description of a product, project, process, or system to satisfy a market need, and the necessary work to provide assurance of its functional safety, reliability, quality, efficiency and economy. It includes the instructions for its realisation, maintenance and use, and the management of the task.

Engineering includes a number of tasks which are not in themselves design. Design, in turn, covers many types of activity where a formal engineering input is unnecessary. However, all other engineering tasks depend for their effectiveness on the design of the artefact in question. Those designs which do not require an identifiable engineering input invariably depend on a mature, or at least reliably available technology. There is an interplay between the concepts of design and engineering, fundamental to both, which makes them inseparable in practice.

The patterns of education, training, and guided experience, vary between different sectors of industry, but the resulting standards of competence at the time when an engineer becomes registered as a Chartered Engineer should be equivalent. In the complex field of engineering, no simple description of design competence can suffice. The Working Party therefore decided to describe a series of discrete competences which together form the overall requirement. Inevitably with such a core topic, many of these overlap with competences needed in other engineering activities. Grouped under three main headings they form the core of the report's discussions. Summarised briefly they are:

NEEDS

At Stage 3 Registration, Chartered Engineers should:

identify the needs of the 'customer' in terms they can recognise, give a clear brief and formal specifications for the design team, as a basis for design and as criteria of success;

appreciate the user's concepts of fitness for purpose, especially in terms of perceived quality and reliability and of their position as

the ultimate arbiter of suitability;

take the responsibility for the long-term effects of engineering design decisions on the environment.

WAYS

At Stage 3 Registration, Chartered Engineers should:

acquire, maintain and apply an intellectual toolkit of creative techniques of exploration, synthesis, analysis, evaluation and team management to tackle the challenges a design task represents, identifying appropriate analytical techniques, including approximations and analogy, to test and confirm the validity of proposed solutions;

use judgement in setting project decisions in the broader contexts of personal experience, company strategy and the needs of the customers, understanding the need for open-minded appraisal of decisions, whether of the product configuration, costs, testing, reliability, or the conduct of the project;

appreciate the need for professional integrity in all dealings with design tasks, maintaining and developing expertise within their fields of responsibility, particularly related to product liability, and health and safety legislation.

MEANS

At Stage 3 Registration, Chartered Engineers should:

understand the important role of communication in its many forms both within the design process and with clients, colleagues and other audiences;

actively develop and maintain good teamwork as an essential ingredient in the design process, whether as a member or the leader of a team, appreciating the importance of giving due credit to the contributions of other team members;

appreciate the particular nature of design management tasks which require leadership skills of a high order;

take account of costing, investment, resources, and other factors, which relate to the company and market environment in which the design will be realised;

understand the need to match the design to a viable means of production, at the conceptual stage, and to incorporate any features into the design which will aid production, without prejudicing the perceived quality of the end result.

The Working Party had a number of problems with terminology. Different engineering sectors use different words with similar connotations, which had to be reconciled: for example, customers, clients, or market; user, operator or driver; manufacture, produce, construct or write (of engineering software or operating manuals); product, construction, artefact or system, and so on. Sometimes we could use words like 'realise' to mean all forms of making things. On other occasions sections were rewritten just to avoid using any of the problem words. Even a word like 'competence' gained specific meanings from various other reports published while we were still working! We hope the final report will be read as a basic statement, with no intended bias and without attaching narrow jargon meanings to words and phrases.

While we have identified a number of constituent design competences, we have not attempted to give more than outline guidance on the levels at which they should be gained. Each sector of the profession has its own needs and priorities which should be determined by the appropriate professional bodies. We have therefore attempted to avoid prescription and provide maximum flexibility while still describing the clear minimum intent of the SARTOR mandatory requirement. ACED says little that is entirely novel although it may be stated in unconventional terms. What we have done is to try to bring the many lines of thought about design in the engineering context into a single coherent statement using consistent terminology not related to a particular discipline or industry.

Reaction to the limited circulation draft in May 1990 was almost entirely positive and welcoming, with many useful suggestions for additional clarification. (As a result, the final report is 60% larger and has a clearer discussion section.) The competences, summarised above, are now broken down into 70 individual areas, the summary is more extensive, and a reference list has been added.

ACED contains a number of recommendations to various bodies which are based on conclusions drawn from our

discussions of competence. Amongst them are proposals to extend the basic concepts to other categories of engineer, and to the training and guided experience phases of initial formation. However, our main hope is that the discussions, and particularly the descriptions of design competence contained within the report, will provide a new foundation for continuing development in matching the supply of newly qualified engineers to the needs of industry, and the nation at large, in terms of their capability to meet the challenges arising from changing technologies and expectations.

FEU TECHNOLOGY DIGEST – SURVEY

We would like comments on the FEU Technology Digests. This will help us to commission the type of articles you would like to read. Would you please fill in this form and return to: Albert Clyde, Development Officer, FEU, Spring Gardens, Citadel Place, Tinworth Street, London SE11 5EH.

1. How many FEU Technology Digests have you read?

1 2 3 (circle)

If less than three, why did you not receive others?

2. Please comment on the articles you have read:

Editorials		**No value**	**Some value**	**Much value**
TD1:	The Concept of Key Technologies			
	The Taguchi Approach to Quality Engineering – Should We Teach It?			
	How Can We Train Users to be Computer Friendly?			
	Introducing New Technology into Building and Construction Curricula			
	Computer-Based Education – Our Changing Society			
TD2:	Integrative Assignments and Design			
	Computer-Based Education – A Student's Response			
	Taking the RISC in FHE			
	Engineering Education in Denmark			
	STARNET: The Shape of Education in the Future			
	Teaching the Social Implications of Technological Change			
TD3:	The Development of an 'Additional Skills' Training Programme			
	Funding CNC Machine Tool Purchases in FE Colleges			
	Satellite Communications for Further Education			
	Attaining Competence in Engineering Design			

3. Would the inputs to the recent FEU Seminar 'Key Technologies in Selected Industries' be valuable to you? (These included Polymers, Biotechnology, Computer Modelling, Telecommunications and Energy.)

none some many

4. Please suggest titles for (or offer to write) articles you would find useful.

5. Have you any comments on recent FEU or FEU/PICKUP reports which you have seen relating to technological areas? These include *The Key Technologies, The Concept of Key Technologies, Training for the Future, Training for Small and Medium Industries, Computer-Aided Production Management.*

Thank you for your help.

Albert Clyde
Development Officer

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